

When calibration is complete, the following screen will appear showing the new ambient value.

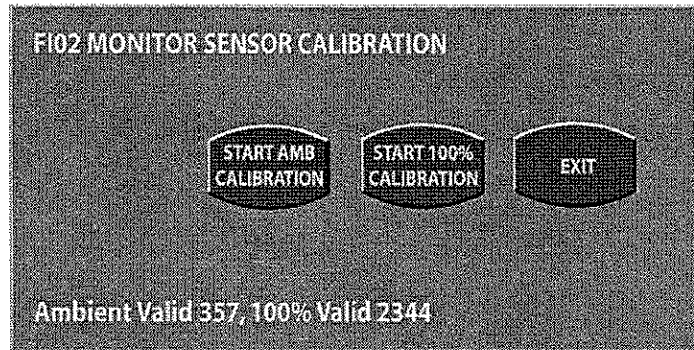


Figure 4.61 Ambient calibration complete showing new value

Press the START 100% CALIBRATION touch screen icon. The calibration will take 3-5 minutes during which time the following screen will appear.

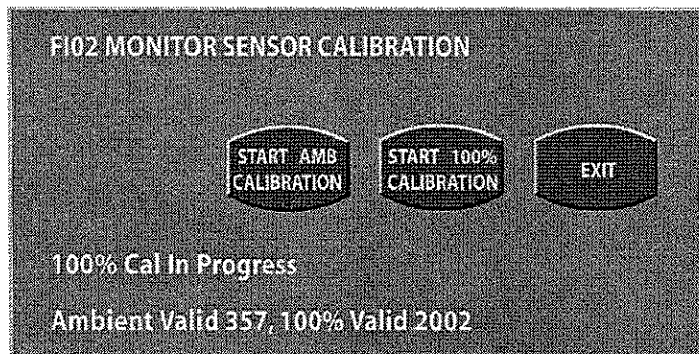


Figure 4.62 100 %FIO2 calibration in progress

When the calibration is complete the following screen will appear.

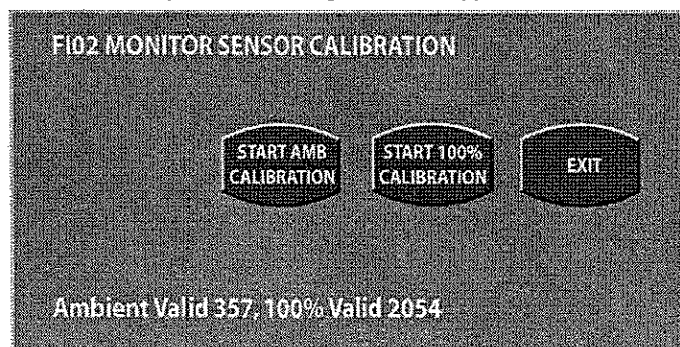


Figure 4.63 FIO2 calibration complete, new values showing.

If the calibration values are acceptable, press EXIT to exit the calibration sequence.

Chapter 5 Maintenance & Troubleshooting

Routine Maintenance Procedures

Replacing the software PCMCIA cards

Occasional software upgrades may require replacement of the internal PCMCIA card that drives the Vela. This is easily access by removing the screws holding the ventilator cover and sliding the cover off towards the rear as shown in figure 5.1.

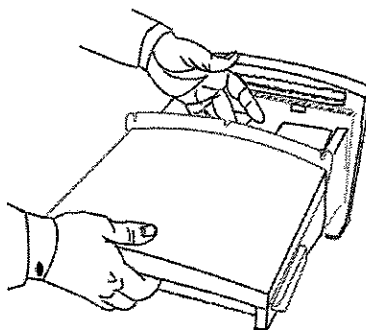


Figure 5.1 Slide cover towards rear

CAUTION

The SVGA Output ribbon cable lies directly beneath the top cover assembly running from the front of the Vela to the rear. It can be damaged if care is not taken when removing the cover. Make sure that the cover clears this cable before sliding it back.

The card is located towards the front of the Vela beneath the right panel. To replace the card, refer to figure 5.2 and do the following:

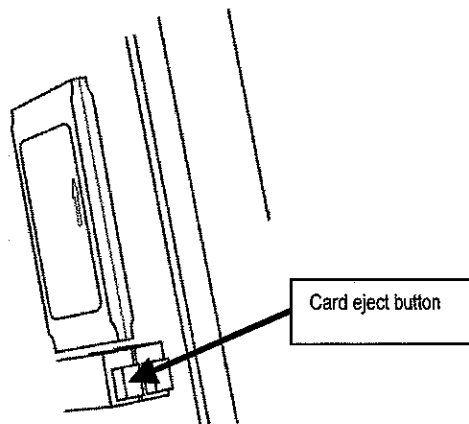


Figure 5.2 PCMCIA cards in place

Note

If a new version of software is installed, it can take up to two minutes for the software to download to the ventilator. During this time the ventilator is inoperative and the audible alarm will sound. The ventilator will resume normal operation once the download is complete.

1. Press the protruding button beneath the card to eject.
2. To install, make sure the arrow on the card is pointing up then push the card into the applicable slot until it clicks into place.

WARNING

It is essential when working inside the ventilator to protect against static discharge, which can damage the ventilator and cause it to become inoperative. ALWAYS take standard ESD precautions before removing the ventilator cover.

Replacing the external A/C fuses.

Remove the power cord protective cover. Unplug the A/C power cord.

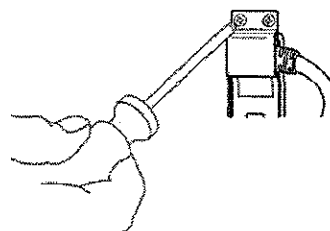


Figure 5.3 Remove the power cord guard

The AC power module is a universal module for A/C voltages from 100-240 volts. Using a flat bladed screwdriver, pry open the cover. Using the same screwdriver, loosen and pull out the red fuse holder as shown in figure 5.4.

Remove the fuses from both sides of the fuse holder and replace with fuses P/N 71612 (available from VIASYS Healthcare customer support).

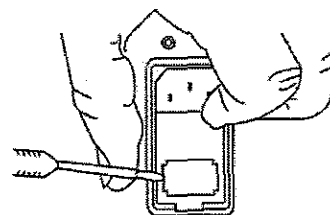


Figure 5.4 Pry out the fuse holder

WARNING

It is important that the fuses are replaced with the same type and value as those removed. Failure to do so can result in ventilator malfunction.

To insert the fuse holder containing the new fuses, make sure the 4 metal tabs are facing up as shown in figure 5.5 and carefully push the fuse holder in to the A/C power module until it seats

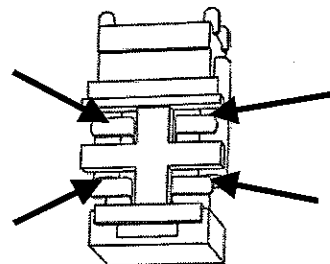


Figure 5.5 Insert fuse holder with metal tabs showing

The Annual 5000 hour P.M. Procedure

Replacing the ambient air filter.

The Ambient Air Filter is located at the rear of the ventilator below the rear panel. It is a high-density foam insert. To remove it, pinch and pull away from the ventilator as shown in figure 5.6. The filter will lift out. Replace with a clean filter. To prevent the entry of dust into the ventilator, press the filter in around the edges to ensure a snug fit.

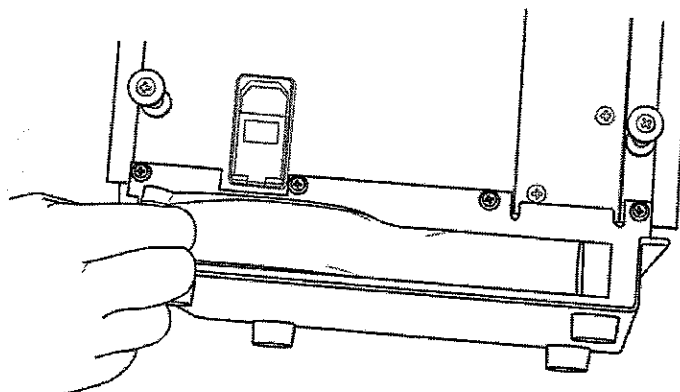


Figure 5.6 Remove high density foam ambient air filter

Replacing the fan filter

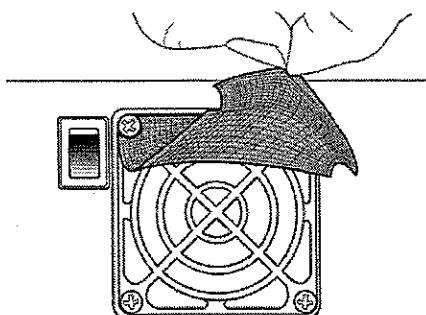


Figure 5.7 Pinch and remove foam fan filter

Pop out the fan filter retaining grid, using screwdriver. Pinch & pull out the foam filter (see figure 5.7)

To install a new filter, carefully place the new filter over the fan housing and place the retaining grid back onto the fan housing. Check to make sure there are no creases or folds in the foam filter as this will reduce its efficiency and could allow contaminants into the ventilator body. Push the retaining grid until all four "tabs" click into place.

Replacing the filter, retaining ring & check valve on the low pres O2 fitting

Using a $\frac{3}{4}$ inch open-ended wrench, unscrew the low-pressure oxygen fitting from the back panel as shown in figure 5.8.

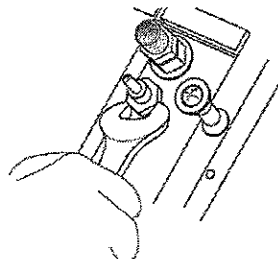
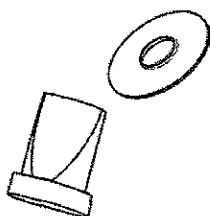


Figure 5.8 Unscrew the low pressure O2 fitting



Remove the white cone filter and dislodge & remove the white Delrin retaining ring (use needle nose pliers if needed).

Using needle nose pliers, the black duck billed check valve should come out easily.

Figure 5.9 White Delrin retaining washer and duck billed check valve

To replace, place the black duck billed check valve and insert it into the fitting. Tap lightly with the end of a screwdriver to make sure it is seated then place the Delrin retaining ring over it with the "lip" facing into the Vela as shown in figure X.X. Place the new cone filter onto the Delrin ring and push gently until you are sure it has seated correctly. Replace the fitting and tighten down with the $\frac{3}{4}$ inch wrench.

Replacing the filter, retaining ring and check valve on the hi pressure fitting

Using a $\frac{3}{4}$ inch open-ended wrench, unscrew the two-piece high-pressure oxygen fitting. Remove the white cone filter, the white Delrin washer & the black duck billed check valve as described above.

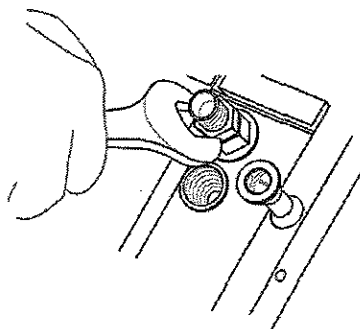


Figure 5.9 Unscrew the high pressure O2 fitting

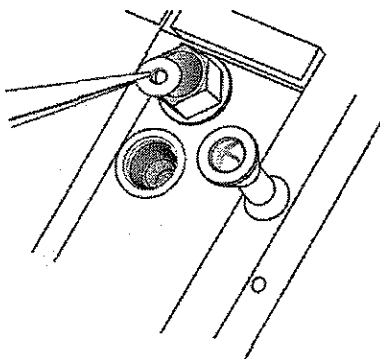


Figure 5.10 Installing the Delrin Washer

Install the black check valve and make sure it is seated. Install the white Delrin washer with the lip down as shown in figure 5.10. Place the cone filter on the delrin washer and push gently to seat. Replace and tighten down the fitting with a $\frac{3}{4}$ inch open-ended wrench.

Replacing the muffler and muffler filter assemblies

Note

Always take precautions against static discharge when working with the ventilator. Retain all hardware for re-assembly.

From the back panel, remove the power cord guard by unscrewing the two retaining screws as shown in figure 5.11. Unplug the power cord.

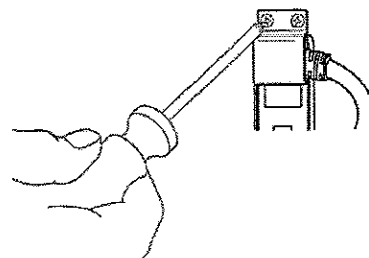


Figure 5.11 Removing the power cord guard

Unscrew the screws holding on the Vela cover. Slide cover towards the rear of the machine and off.

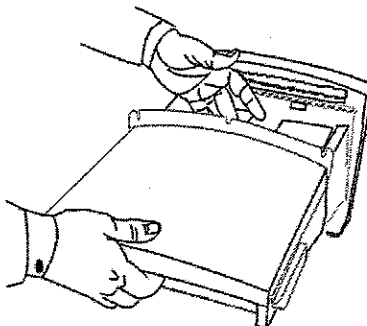


Figure 5.12 Slide cover off towards the rear

Remove the 4 screws securing the battery tray & lift it, and the attached large capacitor assembly out. Lean the battery tray and capacitor assembly against the left side of the Vela while you disconnect the large white Molex DC power connector. Set the complete assembly aside.

Note

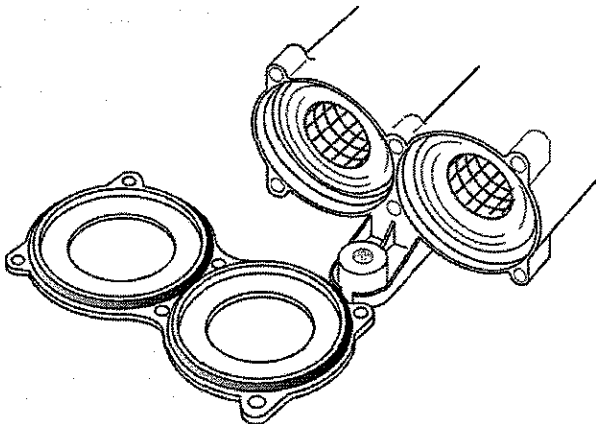
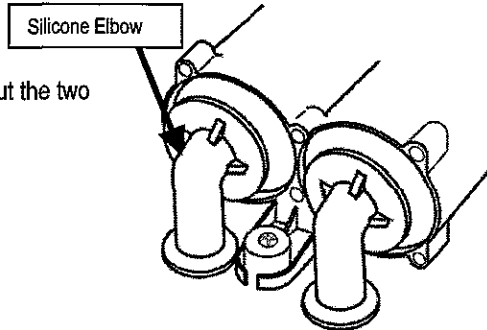
When the batteries are disconnected, the system will automatically re-set the battery status memory and will initiate an 18-hour re-charge cycle upon re-connect. During this period, the red DC status light will remain on. If the DC status light remains lit after the initial charging period has expired, contact VIASYS tech support as described in Appendix A for a replacement battery.

Remove the right panel. There are two screws in the rear of the ventilator, one in the front top and one on the lower left side in the center.

Pull the panel out from the rear first, then ease to the back & tilt out. Lay the assembly flat. The Mufflers are now accessible.

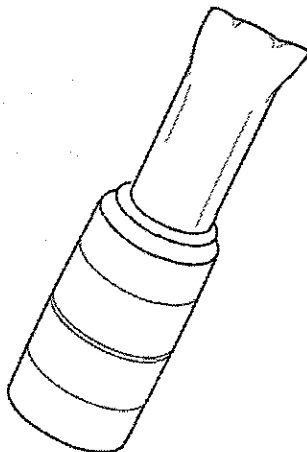
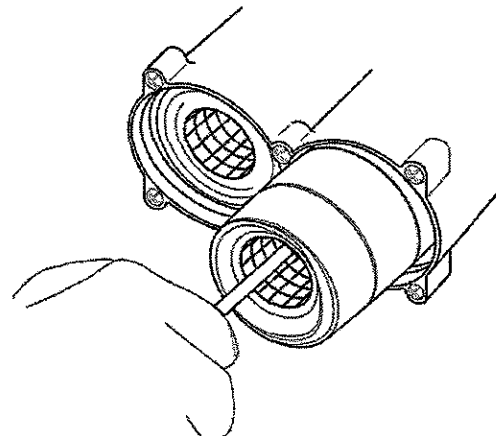
Replacing the muffler/filter assemblies.

To remove & replace the mufflers and filter, first ease out the two silicone elbows from the muffler assembly front panel.



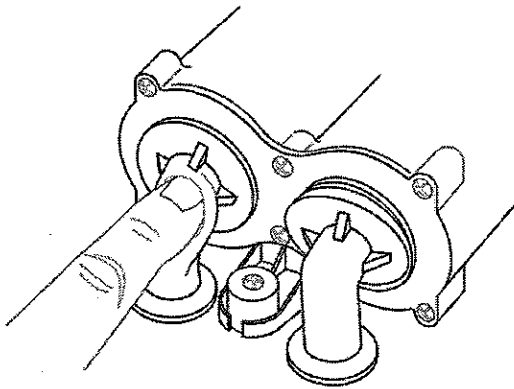
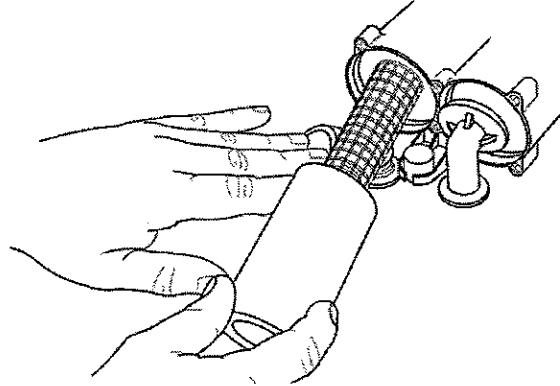
Loosen the 6 screws on the front plate, & remove the front plate. Remove and replace the two black o-rings on the front panel.

Using needle nose pliers, firmly grasp the metal grid inside the R side muffler/filter assy. Pull firmly towards you and the muffler/filter should slide out. Repeat with the left side muffler.



You will see that only the Right side muffler has a filter attached, the L side has wire muffler only.

To install the new filter/muffler assemblies, push the left side muffler (with no filter) firmly in and make sure it is pushed all the way into the housing. Insert the right side muffler with the filter, ensure that the seam on the filter lays horizontally and press home. Replace the front cover with the new O-rings and reattach with six screws.



Install the two silicone elbows into the muffler cover and push in the center to make sure they are seated.

Replacing the left panel w/power PCB.

1. Lean the right panel up to the Vela, slide in the front then push in the rear. Reattach the screws on the rear (2), front (1) and at the lower edge of the right side (1).
2. To install the battery tray, re-attach the large white Molex connector and make sure it lays between the muffler elbows as you replace the battery tray onto the Vela. This will ensure that there is enough space for the large capacitor attached to the Battery tray. Re-attach the 4 screws holding the battery tray in place. Reconnect the ribbon cable.
3. Slide the cover in place from the rear and push the top front edge home under the lip. Attach the screws.
4. Reattach the power cord and re-attach the power cord guard with the two screws.

Troubleshooting

If The Ventilator Does not Turn ON

If you turn the power switch ON and the ON indicator does not illuminate, perform the troubleshooting procedures given in Table 5.1.

Table 5.1
Troubleshooting Power-Up Problems

PROBLEM	POSSIBLE CAUSE	ACTION
Ventilator plugged into an AC source but does not power up.	No power at AC outlet, or the AC/DC select switch is in the ALT PWR SOURCE position, or the AC Line Voltage switch is set to the wrong voltage.	Try connecting to a known good AC power source. Make sure the AC/DC switch is in the AC position. Make sure, the voltage setting of the ventilator matches the voltage of your power source. Check the fuse assembly if the ventilator still does not power up. Contact your Bird Products Certified Service Technician. Check the DC voltage output supply from transformer at J9. Check DC voltage at J3. Black is ground. Red is 5 volts DC and Yellow is 14.7 to 20 DC. If voltage is not present, replace Power Supply PCB.
Ventilator attached to alternate external DC power source but does not power up.	If the external source is a battery, the battery may not be charged, or the AC/DC select switch may be in the AC position.	Plug the ventilator into a known good AC source, or to a known good battery and see if it powers up. If using a 12VDC power source, set the AC/DC select switch to the ALT PWR SOURCE position. Check the fuse assembly. If the ventilator still does not power up, contact your Bird Products Certified Service Technician. Check DC voltage at J3. Black is ground. Red is 5 volts DC and Yellow is 14.7 to 20 DC. If voltage is not present, replace Power Supply PCB.

Reviewing the Transducer Waveforms

To review the transducer waveforms set in Chapter 4, in normal operational mode press the touch screen immediately over the waveform heading display on the MAIN screen.

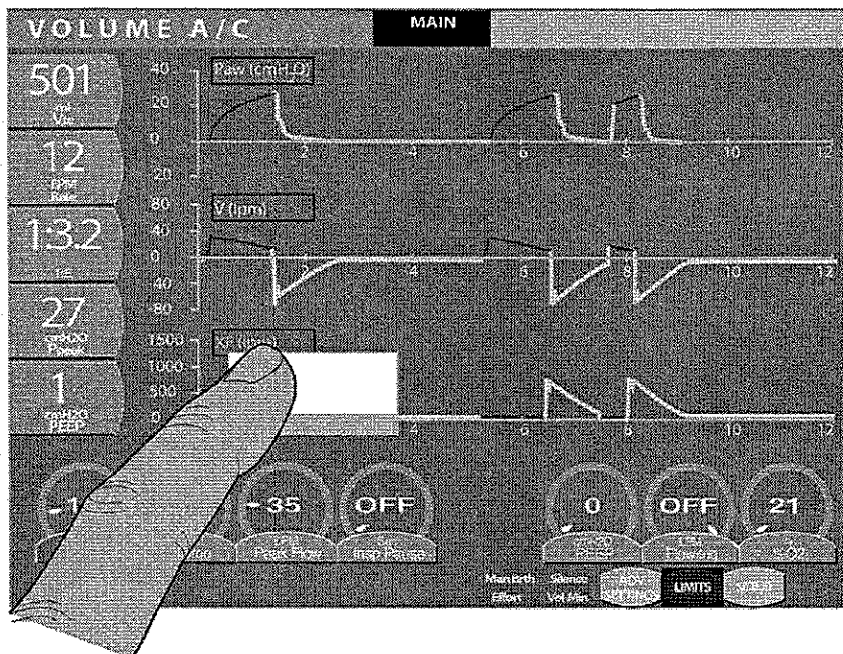


Figure 5.13 Select waveform displayed

A scrolling drop down menu displays all the possible waveform choices. To scroll through the choices use the Data Dial.

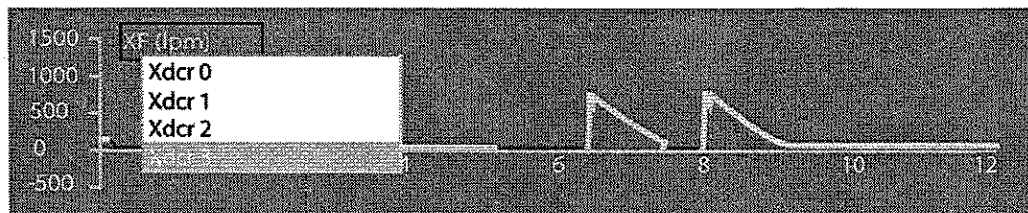


Figure 5.14 Drop down menu

From the choices displayed, select the transducer you wish to review (in this case, transducer 0) and press the Accept membrane button.

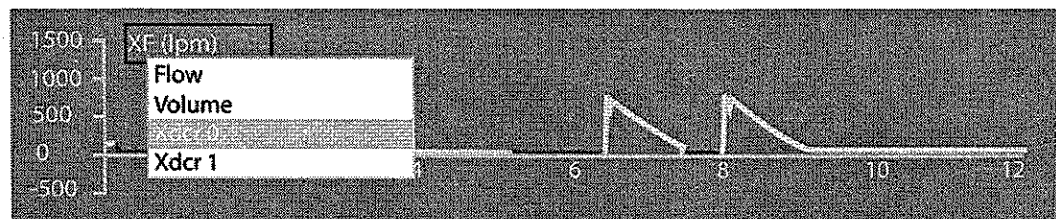


Figure 5.15 Selecting Xducer

The waveform immediately changes to display the signal associated with the selected transducer (in this case it is Turbine Speed).

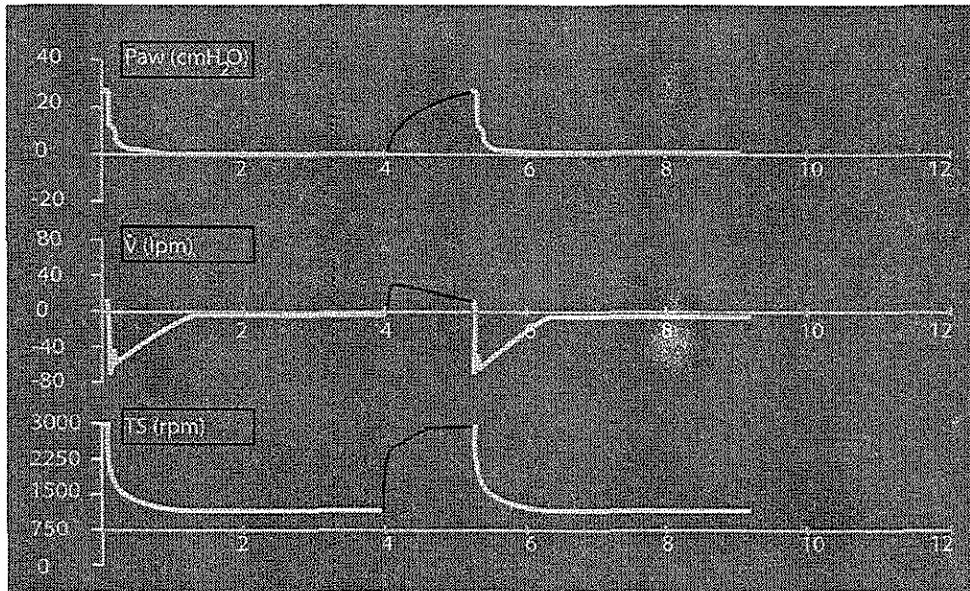


Figure 5.16 Turbine Speed waveform displayed

Appendix A Contact & Ordering Information

How to Call for Support

To get help on performing any of the preventive maintenance routines, or to request service on your ventilator, contact VIASYS Healthcare Customer Care:

Technical Support

Hours: 7:00 AM to 3:30 PM (PST) Monday through Friday
Phone: (760) 778-7200
Fax: (760) 778-7377

VIASYS Healthcare Customer Care Helpline

Hours: 24 hours, seven days a week
Phone: (800) 934-2473 (From within the US)
Fax: (760) 778-7377

VIASYS Healthcare Critical Care
1100 Bird Center Drive
Palm Springs, CA 92262-8099
U.S.A.

Phone: (760) 778-7200
(800) 328-4139
Fax: (760) 778-7274

Ordering Parts

To obtain Vela ventilator parts contact customer service at:

Customer Service:

Hours: 7:00 Am to 3:30 PM (PST)

Monday through Friday

Phone: (800) 328-4139

(760) 778-7200

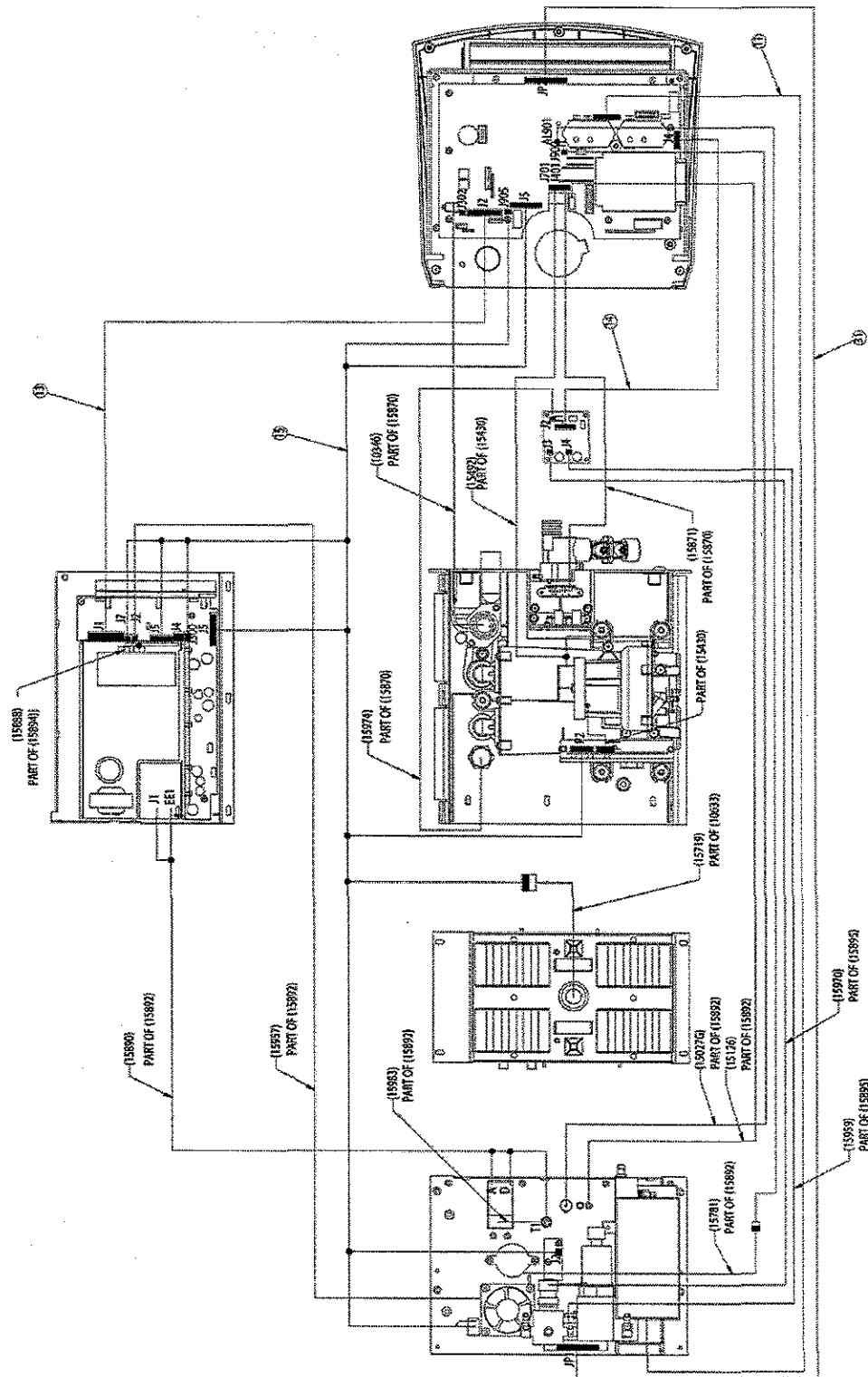
Fax: (760) 778-7274

Appendix B Diagrams & Schematics

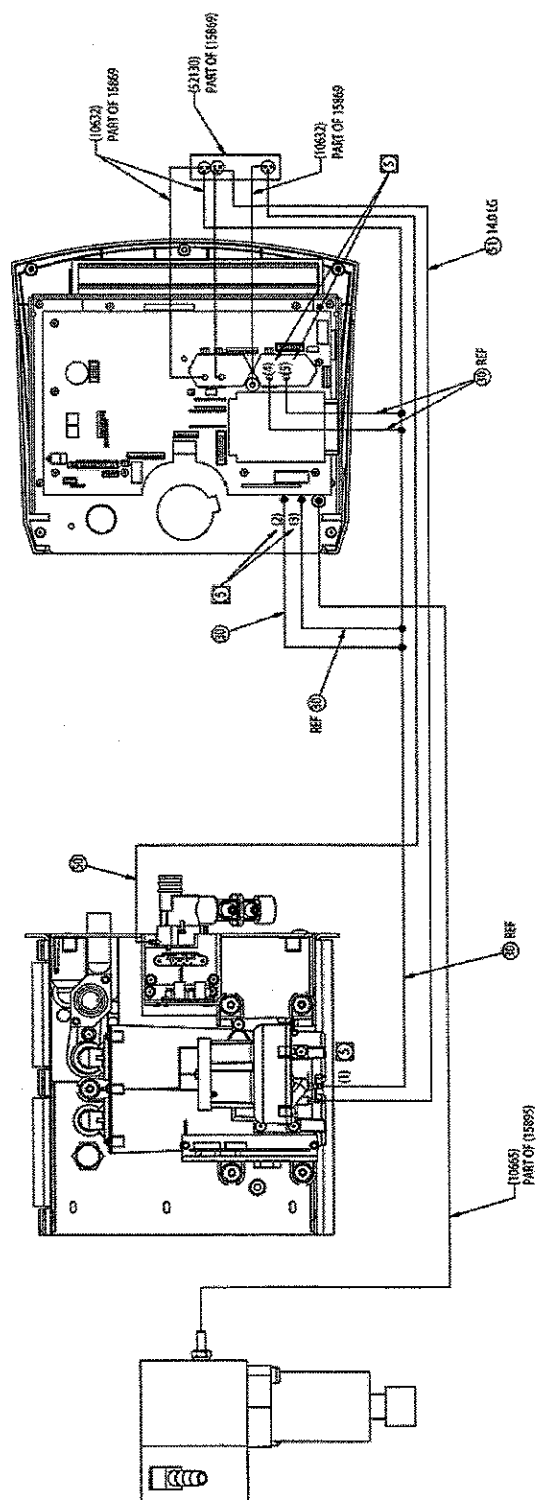
Wiring Diagram

Tubing Diagram

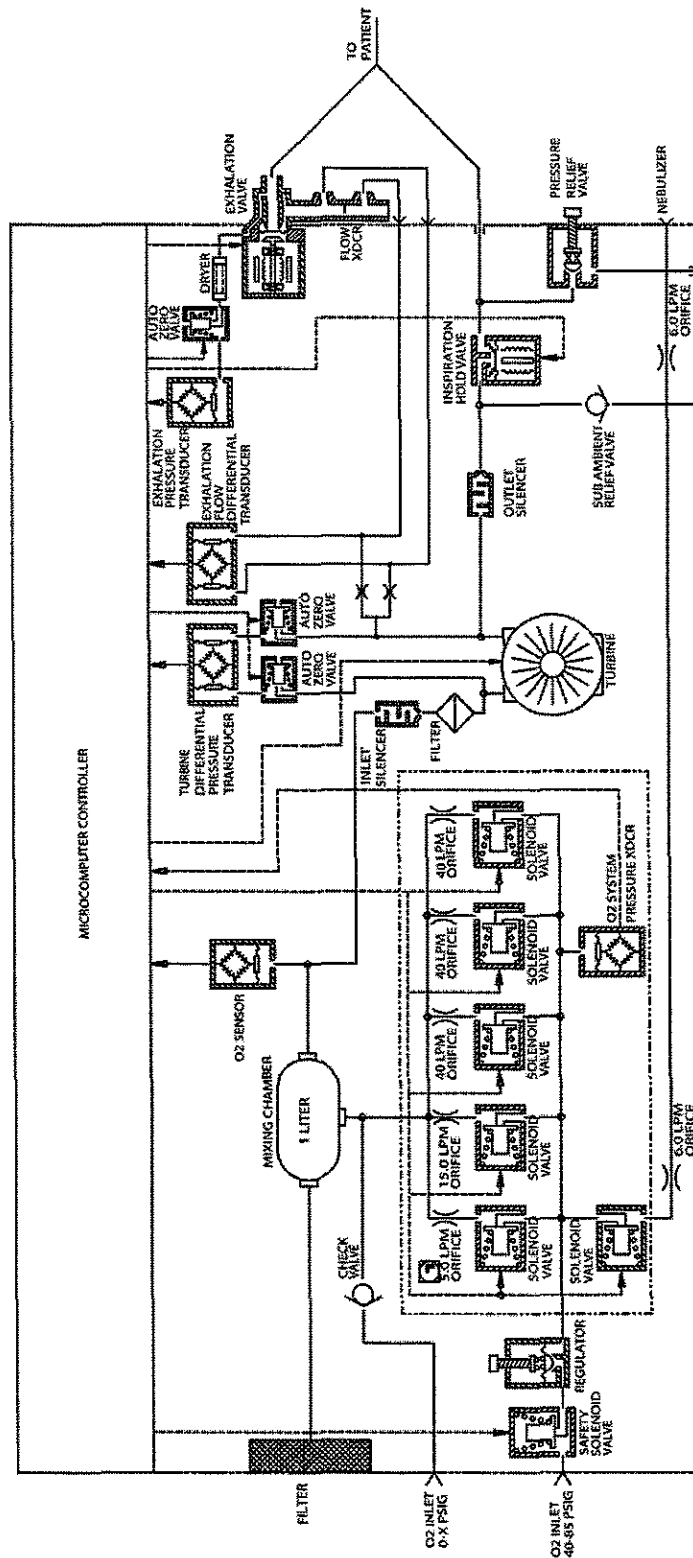
Pneumatic Schematic



15867E WIRING DIAGRAM



15867E
PNEUMATIC DIAGRAM



**SCHEMATIC,
PNEUMATIC SYSTEM - VELA**

NOTE: UNLESS OTHERWISE SPECIFIED.

ALL OXYGEN FLOWS CALIBRATED AT 40 PSIG
INLET PRESSURE.

Appendix C Specifications

Oxygen Supply

High Pressure Connector

Pressure Range:	40 to 85 psig (Supply Oxygen)
Temperature:	10 to 40 °C (50 to 104 °F)
Humidity:	Dew Point of gas should be 1.7 °C (3 °F) below the ambient temperature (minimum)
Minimum Flow:	80 LPM at 20 psig
Inlet Fitting:	CGA DISS-type body, No. 1240

Low Pressure Connector

Pressure Range:	0 to 0.5 psig (Supply Oxygen)
Maximum Flow:	80 LPM
Inlet Fitting:	¼ inch tapered

Electrical Supply

AC Power Supply

The ventilator operates within specification when connected to the following AC power supplies:

Nominal	Voltage Range	Frequency Range
100 VAC	(85 to 110 VAC)	47 to 65 Hz
120 VAC	(102 to 132 VAC)	55 to 65 Hz
230 VAC	(196 TO 253 VAC)	47 to 65 Hz
240 VAC	(204 TO 264 VAC)	47 to 65 Hz

DC Power Supply

The ventilator can also operate from a 48 VDC power source (internal battery).

Internal Battery:

The ventilator operates within specification for approximately 3 hours with a fresh, fully charged battery under moderate load. Maximum charge time for a full charge is 8 to 12 hours.

Data Input / Output

Analog Inputs

The ventilator provides up to 8 programmable channels for analog signal inputs. Each channel shall be scalable for the input ranges specified.

Ranges:	0 to 1 VDC
	0 to 5 VDC
	0 to 10 VDC
Resolution:	0.25 mV (for 0 to 1 VDC)
	1.37 mV (for 0 to 5 VDC)
	2.5 mV (for 0 to 10 VDC)

Analog Outputs

The ventilator provides 4 signals at the analog output connector:

1. Airway Pressure, P_{AW} :

Range:	-60 to 140 cmH ₂ O
Scale:	1 cmH ₂ O/25 mV
Accuracy:	± 50 mV or $\pm 5\%$ of reading, whichever is greater
Zero Offset:	1.5 VDC at 0 cmH ₂ O

2. Flow

Inspiratory/Expiratory:

When selected, the ventilator provides a continuous analog voltage representative of inspiratory flow minus expiratory flow.

Range:	-300 to 200 LPM (Adult)
Scale Factor:	1 LPM / 10 mV (Adult)
	1 LPM / 25 mV (Pediatric)
	1 LPM / 50 mV (Neonate)
Accuracy:	$\pm 10\%$ of reading or ± 30 mV, whichever is greater
Zero Offset:	3.0 VDC at 0 LPM

Machine:

When selected the ventilator provides a continuous analog voltage representative of machine delivered flow.

Range:	0 to 200 LPM (Adult)
Scale Factor:	1 LPM / 25 mV (Adult)
	1 LPM / 50 mV (Pediatric)
	1 LPM / 100 mV (Neonate)
Accuracy:	$\pm 10\%$ of reading or ± 30 mV, whichever is greater
Zero Offset:	None

3. Volume:

Range: -1.00 to 4.00 L (Adult)

Scale Factor: 1 L / V (Adult)

1 mL / 5 mV (Pediatric)

1 mL / 10 mV (Neonate)

Accuracy: $\pm 10\%$ of reading or ± 30 mV, whichever is greater

Zero Offset: 1.000 VDC

4. Breath Phase

The ventilator provides a continuous analog voltage representative of breath phase (Inspiration = 5 VDC, Expiration = 0 VDC).

Digital Communication

The ventilator is constructed with one RS-232 port for bi-directional communication of data.

CAUTION

This is a non-operational port. Do not make connection.

Printer

The ventilator is constructed with a standard 25-pin female Centronics parallel printer port.

CAUTION

This is a non-operational port. Do not make connection.

Remote Nurse Call

The ventilator has a modular jack configured to interface with external systems that are either wired for normally open (N.O., close on alarm) or normally closed (N.C., open on alarm) signals.

Video Output

The ventilator is constructed with a video output connector.

CAUTION

This is a non-operational port. Do not make connection.

Atmospheric & Environmental Specifications**Temperature and Humidity****Storage**

Temperature: -20 to 60 °C (-4 to 140 °F)

Humidity: 10 to 95% RH non-condensing

Operating

Temperature 5 to 40 °C (41 to 104 °F)

Humidity 15 to 95% RH non-condensing

Barometric Pressure

760 to 545 mmHg

Physical Dimensions**Overall Size**

13" W x 14.5" D x 12" H

Weight

≤ 38 lbs.

Appendix D Service Event Codes

CODE	DESCRIPTION
1	MSP got an unrecognized packet from IOP
2	IOP did not remove the high priority packet last sent to it
3	IOP did not send the event packet in time
4	MSP detected a checksum error in a high priority packet
5	MSP detected too many checksum errors in lo priority communications
6	MSP unknown breath phase
7	MSP unknown mode
8	MSP unknown breath type
9	An msp task didn't run. Detected by the backgnd task.
10	userint task got an invalid enumeration for a switch or an alarm
11	Servos detected an invalid servo type
12	TEPROM detected checksum error in turbine eeprom
13	All required queues were not active on power up
14	A queued "pass around" message did not get back
15	A queued "pass around" message was responded by the wrong task
16	The queue of IOP messages was full
17	Turbine out of control, flow parameter
18	Turbine out of control, speed parameter
19	Turbine out of control, exhl pressure parameter
20	Turbine out of control, turb pressure parameter
21	Indicates a problem with the speed encoder
22	Indicates a problem with the turbine differential pressure transducer
23	The turbine is running in reverse
24	The O2 sensor is disconnected
25	Ambient air reading is too low
26	The 100% cal A/D reading is too low
27	The A/D readings never stabilized during a calibration
28-39	UNUSED
40	MSP code ran away, hit runaway trap, CPU can't recover
41	MSP addressed a nonresponsive memory/device or a nonexistent memory/device
42	IOP did not interrupt MSP within 2.1ms
43	MSP undefined interrupt error
44	MSP invalid opcode error
45	MSP spurious interrupt error
46	MSP divide by zero interrupt
47	MSP parity error
48	UNUSED
49	MSP watchdog pal error
50	MSP BACKGND task found a ROM checksum error
51	MSP INTO instruction executed, overflow flag was set
52	MSP GP fault
53	MSP Stack fault
54	MSP Bound error
55	MSP task MSG tried to enqueue a message, but the message queue was full
56	MSP configuration key was removed or changed
57-59	UNUSED
60	MSP discovered that there was no cal data
61	Transducer fault occurred
62	User svt calibration failed
63	User interface could not use settings from non-volatile ram
64	Vent powered-up
65	Self reset occurred
66	Turbine S/N in eeprom doesn't match teprom
67	AC power alarm occurred
68	External battery alarm occurred
69	Internal battery medium alarm occurred

70-199	UNUSED
200	MSP POST: CPU command failure
201	MSP POST: CPU timer failure
202	MSP POST: Internal RAM failure
203	MSP POST: External DPRAM failure
204	MSP POST: Program Memory Checksum calculation failure
205	IOP executed unused code space
206	IOP Background checksum test failed
207	IOP checksum
208	IOP checksum
209	IOP external 32k sram failure
210	Three consecutive exhalation pressure mismatches
211	Three consecutive exhalation flow mismatches
212	Three consecutive turbine pressure mismatches
213	Three consecutive internal battery charge mismatches
214	Three consecutive external battery charge mismatches
215	Three consecutive oxygen pres mismatches
216	Three consecutive temperature mismatches
217	Three consecutive exhalation valve DAC mismatches
218	Three consecutive turbine DAC mismatches
219	Three consecutive 48 volt supply mismatches
220	Three consecutive O2 monitor voltage mismatches
221	Three consecutive internal reference voltage mismatches
222-229	UNUSED
230	IOCOMM: No servo data for the DACs written to memory
231	IOCOMM: A/D data not retrieved from memory
232	IOCOMM: Incorrect checksum
233	IOCOMM: Illegal command
234	IOCOMM: Incorrect packet size
235	IOCOMM: Incorrect command handler called
236	IOCOMM: Parameter was out of range
237	IOCOMM: IOP did not receive an MSP packet for over 100 ms
238	No MSP sync within 2sec of IOP post finished
239-247	UNUSED
248	IOP discovered a fan failure
249	IOP discovered a fan failure condition has ended
250	Three consecutive IOP discovered DAC loop-back failure
251	IOP discovered power supply over-temp
252	IOP discovered DAC loop-back is ok
253	IOP discovered power supply is ok

Glossary

Breath Interval	Elapsed time from the start of one breath to the start of the next.
Preset	An operator set ventilator parameter.
Trigger	Value at which the ventilator initiates delivery of a breath as a result of measured patient effort.
BTPS	Body Temperature at Ambient Pressure, Saturated.
ATPD	Ambient Temperature, Ambient Pressure, Dry.
Demand Flow	The flow generated by the ventilator to meet the patient's flow demand in order to maintain PEEP at the preset level.
PEEP	Positive End Expiratory Pressure.
AC	Alternating Current (mains electricity).
Bias Flow	A continuous flow through the patient breathing circuit.
Bpm	Breaths per minute.
Breath Period	The length of time between machine-initiated breaths. Depends on the Breath Rate setting.
Breath Rate	The number of breaths delivered in a minute.
BTPD	Body Temperature at Ambient Pressure, Dry
Button	A push button switch used to toggle a function on or off.
cmH ₂ O	Centimeters of water pressure.
Controls	Any button, touch screen icon, switch, or knob that allows you to modify the ventilator's behavior.
Event	An anomalous condition that occurs during ventilator operation.
Flow	The rate at which gas is delivered. Measured in liters per minute (lpm).
Indicators	A visual element showing operational status.
L	Liters. A unit of volume.
LED	Light Emitting Diode
L/min	Liters per minute. A unit of flow.
Mode	An operating state of the ventilator that determines the allowable breath types.
Monitored Parameter	A measured value displayed in the screen.
O ₂	Oxygen
Patient Breathing Circuit	The tubing that provides the ventilatory interface between the patient and ventilator.
Paw	Airway Pressure. Measured in cmH ₂ O at the exhalation valve.

PEEP	See Positive End Expiratory Pressure.
PIP	Peak Inspiratory Pressure . Shows the highest circuit pressure to occur during inspiration as measured at the exhalation valve. The display is updated at the end of inspiration. PIP is not updated for spontaneous breaths.
Pplat	Plateau Pressure. Measured during an Inspiratory Hold maneuver. Used to calculate Static Compliance. (Cst).
PSIG	Pounds per square inch gauge. 1 PSIG = .07bar
Sigh Breath	A Volume Controlled machine breath having a tidal volume equal to one-and-a-half times (150% of) the current tidal volume setting.
User Verification Tests (UVT)	A group of tests to check ventilator performance prior to connecting the ventilator to a patient.
WOB	Patient Work of Breathing i.e. a measure of Patient Effort.

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